BRANCHED ELECTRICAL CONDUCTORS

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Inventor(s):
Applicant(s): RAYCHEM GMBH
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Abstract

1523602 Branching tape cables RAYCHEM GmbH 27 June 1975 [28 June 1974] 27324/75 Heading H1A [Also in Division H2] To form a branch from a cable a loop is made and part of the insulation removed from the cable in the loop portion to expose a conductor. In embodiments using ribbon cable a U-shaped loop 5 is formed, the shanks 7, 9 of the loop are bonded together, with or without adhesive 15, and an insulating mandrel 13 may be inverted behind the conductors 1 at the U-turn when they are bored. The mandrel may be recessed to support the conductors (Fig. 3, not shown) and the assembly used as the male portion of a two-part coupling.

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(72) Inventor WERNER MELCHIOR ALLGAIER

(54) BRANCHED ELECTRICAL CONDUCTORS

(71) We, RAYCHEM GmbH., a Body Corporate organised according to the laws of Germany, of Wernher-von-Braun Strasse 11, 8011 Putzbrunn, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates an electrical cable system comprising a length of flexible flat cable having a branch lead at an intermediate point in the length thereof.

The term "flat cable" is used herein to denote a cable comprising a plurality of parallel conductors which are surrounded by electrically insulating material, which may be cross-linked. Such cable can be prepared by extruding the insulating material around a plurality of conductors, or by joining together a plurality of parallel insulated conductors, either directly to each other or to a backing sheet. The conductors may be rectangular or round in cross-section. It is often necessary to provide a branch lead to one or more of the conductors of a flat cable, and the known methods for providing such branch leads suffer from a variety of disadvantages.

The present invention provides an improved branched cable system and method for providing a branch lead on a flat cable.

In its first aspect, the invention provides an electrical cable system which comprises a length of flexible flat cable comprising a plurality of parallel electrical conductors which are of constant cross-section and are surrounded by electrically insulating material, said cable having a branch lead formed at an intermediate point in the length thereof by means of a generally U-shaped loop of the cable, the loop having shanks which are joined together with the aid of an adhesive or through melt-fusion of the electrically insulating material, the conductors running continuously through the loop and at least one of the conductors having an exposed contact zone (as hereinafter defined) on the outer surface thereof in the region of the turn of the loop, the zone extending part of the way down each shank of the loop.

When the flat cable is of the standard type comprising a plurality of straight parallel conductors, the loop is preferably formed so that each of the conductors lies in a plane.

The term "exposed contact zone" is used herein to denote a zone on the conductor from which the insulating material has been completely removed so that the conductor can be directly contacted, without passing through any insulation, from a direction at right angles to the axis of the conductor. Thus the term does not include a zone from which the insulating material has been displaced by means of teeth which pass through the insulating material and thus make contact with the conductor.

In its second aspect, the invention provides a method of providing a branch lead at an intermediate point in a length of a flexible flat cable comprising a plurality of parallel electrical conductors which are of constant cross section and are surrounded by insulating material, which method comprises

(1) at an intermediate point in the length of the cable, removing at least part of the insulating material covering at least one of the conductors to provide an exposed contact zone (as hereinbefore defined) on the conductor;

(2) folding the cable at about the mid-point of the exposed contact zone to form a generally U-shaped loop in the cable so that there is an exposed contact zone on at least one of the conductors, on the outside of each of the shanks of the loop; and

(3) joining the shanks of the loop together with the aid of an adhesive or through melt-fusion of the electrically insulating material.

The shanks of the loop are joined together so that the part of the cable from which the insulating material has been removed is relieved of any mechanical load which may be placed on the main length of the cable. The shanks can be joined to each other by means of an adhesive, or (with suitable insulating materials) by melt-fusing together the insulating material of the inner surfaces of the shanks or by placing a sheet of a suitable thermoplastic material between the shanks and melt-fusing the thermoplastic material to the insulating material on the inner surface of each shank. For added mechanical strength a metal foil can be secured between the shanks for example by joining the shanks together by means of a metal foil coated on each side with an adhesive.

It is usually both convenient and desirable to remove the insulating material from all the conductors, for example by removing the insulating material uniformly across the width of a cable comprising a plurality of straight parallel conductors, for example by milling. It is also preferred that the or each conductor having an exposed contact zone should have been completely bared of the insulating material in the region of the turn of the loop. The completely bared conductor can be folded around an electrically insulating support member (e.g. of U-shaped cross-section), preferably one having a recess for the or each bared conductor, or simply folded on itself. When a support member is used, it can for example be a moulded article of a plastics material, with a first portion for insertion between the superposed portions of the insulation and a second portion integral with and of wider cross-section than the first portion for supporting the bared portions of the conductors, the insert extending across the total width of the cable. The second portion may be provided with a plurality of ribs for defining recesses in which the individual bared conductors may be received.

The branch lead can be of any required length, and there can be a plurality of branch leads at desired intervals along the length of the cable. The end of the branch lead can be in the form of the male part of a plug-and-socket connection which can be easily inserted into the female part of the connection.

The uses of the branched cable system of the invention are diverse and range from the wiring of stationary circuits to applications in apparatus subjected to heavy mechanical loads, for example prefabricated electronic units in vehicles, aircraft or space satellites.

The invention will now be described by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a ribbon cable;

Figure 2 is a longitudinal section through the ribbon cable of Figure 1 in a plane through a conductor, and

Figure 3 is a section through a ribbon cable in the position indicated by the line III-III in Figure 1 and shows a modified form of insulating core.

Referring now to the drawings, three flat conductors 1, made, for example, of copper are completely embedded in a strip 3 of electrically insulating plastics material, for example polyethylene, to form a ribbon cable.

To form a branch lead, generally designated by the reference numeral 5, a U-shaped loop, the two shanks 7 and 9 of which are superposed one on the other, is formed in a zone intermediate of the ends of the ribbon cable. Insulating material is removed from the strip 3 of plastics material in the region 11 of the turn of the U-shaped loop, so that the conductors 1 extend out of the portion of the strip 3 forming one shank of the loop and then turn back into the portion of the strip forming the other shank of the loop. In this region 11, at the closed end of the U-shaped loop, the conductors 1 are passed round an insulating core 13 having a U-shaped cross-section. Between the portions of the strip 3 of plastics material forming the two shanks of the U constituting the branch lead 5 is positioned a layer or film 15 of, for example, thermoplastic material by means of which the two portions of the strip of plastics material are joined to each other. The thickness of the insulating core 13 at the places where the portions of the strip bear against the core is equal to the sum of the thickness of the layer or film 15 and twice the thickness of the layer of plastics material remaining between a conductor 1 and the exterior of the strip 3 of plastics material. This ensures that each conductor 1 is not bent sharply where it passes out of the portion of the plastics strip 3 forming one shank 7 in the region of the turn of the U-shaped loop and runs back again into the portion of the plastics strip 3 forming the other shank 9.

As shown in Figure 3, the insulating core 13 may have recesses formed therein in which the conductors 1 are accommodated, so that the conductors are firmly guided and mechanically protected. In their bared regions the conductors shown in Figures 1 to 3 can be coated with a noble metal, for example gold, so that they do

not oxidize and the service-life of their contact surfaces may be extended.

To form a branch lead 5 as illustrated in the drawings, the strip 3 of plastics material is first removed from the cable over a length corresponding to the length of that portion of each conductor 1 that is to be bared in the region 11 of the turn of the U-shaped loop. This can be done in any suitable manner, for example by milling. Thereafter, the U-shaped loop is formed in the ribbon cable, the film or layer 15 of thermoplastics material is positioned between the two shanks of the U-shaped loop, and the insulating core 13, which may if desired be formed integrally with the film 15, is positioned in the region of the bared conductors 1. The two shanks 7 and 9 of the U-shaped loop are then pressed together and are heated to an extent depending upon the nature of the film 15 so that they adhere to each other. The contact end of the branch lead 5, comprising the portions of the conductors 1 which pass round the insulating core 13 and are bared on their surfaces, is very stable and can itself form the male part of a plug-and-socket connection.

In a modified form of the branched cable of the invention, the insulating core illustrated in Figures 1 to 3 may be dispensed with by removing insulation only from the outside of the bend of the U-shaped loop and causing the two layers of insulation remaining on the inside of the bend to adhere to each other, for example by the use of a thermoplastic film or by direct bonding of the insulation, to support the bared regions of the conductors.

WHAT WE CLAIM IS:

1. An electrical cable system which comprises a length of flexible flat cable comprising a plurality of parallel electrical conductors which are of constant cross-section and are surrounded by electrically insulating material, said cable having a branch lead formed at an intermediate point in the length thereof by means of a generally U-shaped loop of the cable, the loop having shanks which are joined together with the aid of an adhesive or through melt-fusion of the electrically insulating material, the conductors running continuously through the loop and at least one of the conductors having an exposed contact zone (as hereinbefore defined) on the outer surface thereof in the region of the turn of the loop, the zone extending part of the way down each shank of the loop.

2. A system according to Claim 1 wherein each of the conductors has a said exposed contact zone.

3. A system according to Claim 1 or 2 wherein the or each conductor having a said exposed contact zone has been completely bared of the insulating material in the region of the turn of the loop.

4. A system according to Claim 3 wherein the or each bared conductor passes around an electrically insulating support member.

5. A system according to Claim 4 wherein the support member comprises a recess for the or each bared conductor.

6. A system according to any one of the preceding claims wherein each of the conductors lies in a plane.

7. A system according to claim 3 wherein the shanks of the loop are joined together by means of an adhesive.

8. A system according to any one of Claims 1 to 6 wherein the shanks of the loop are joined together by a melt-fused layer of insulating material on the inner surface of each shank.

9. A system according to any one of claims 1 to 6 wherein the shanks of the loop are joined together through a film of thermoplastic material which has been melt-fused to insulating material on the inner surface of each shank.

10. A system according to any one of the preceding claims wherein each of the conductors having an exposed contact zone is inserted into a femal socket and makes electrical connection therewith.

11. A system according to any one of the preceding claims wherein each of the conductors is of substantially rectangular cross-section.

12. An electrical cable system substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

13. A method of providing a branch lead at an intermediate point in a length of a flexible flat cable compriding a plurality of parallel electrical conductors which are of constant cross section and are surrounded by insulating material, which method comprises

(1) at an intermediate point in the length of the cable, removing at least part of the insulating material covering at least one of the conductors to provide an exposed contact zone (as hereinbefore defined) on the conductor,

(2) folding the cable at about the midpoint of the exposed contact zone to form a generally U-shaped loop in the cable, so that there is an exposed contact zone on at least one of the conductors, on the outside of each of the shanks of the loop; and

(3) joining the shanks of the loop together with the aid of an adhesive or through melt-fusion of the electrically insulating material.

14. A method according to Claim 13 wherein at least part of the insulating

material covering each of the conductors is removed to provide an exposed contact zone on each of the conductors.

15. A method according to Claim 13 or 14 wherein the insulating material is completely removed from each of the conductors in the region of the turn of the loop.

16. A method according to Claim 15, wherein the bared conductors are folded about an electrically insulating support member.

17. A method according to Claim 16 wherein the support member comprises a recess for each of the bared conductors.

18. A method according to any one of Claims 13 to 17 wherein the cable comprises a plurality of straight, parallel conductors and the insulating material is removed uniformly across the width of the cable.

19. A method according to any one of claims 13 to 18 wherein the shanks of the loop are joined together by melt-fusing together the insulating material of the inner surfaces thereof.

20. A method according to any one of claims 13 to 18 wherein the shanks of the loop are joined together by placing a sheet of thermoplastic material between the shanks and melt-fusing the thermoplastic material to the insulating material on the inner surface of each shank.

21. A method according to claim 15 wherein the shanks of the loop are joined together by means of an adhesive.

22. A method according to Claim 13 substantially as hereinbefore described.

ABEL & IMRAY,
Chartered Patent Agents,
Northumberland House,
303-306 High Holborn,
London WC1V 7LH.

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1 523 602 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

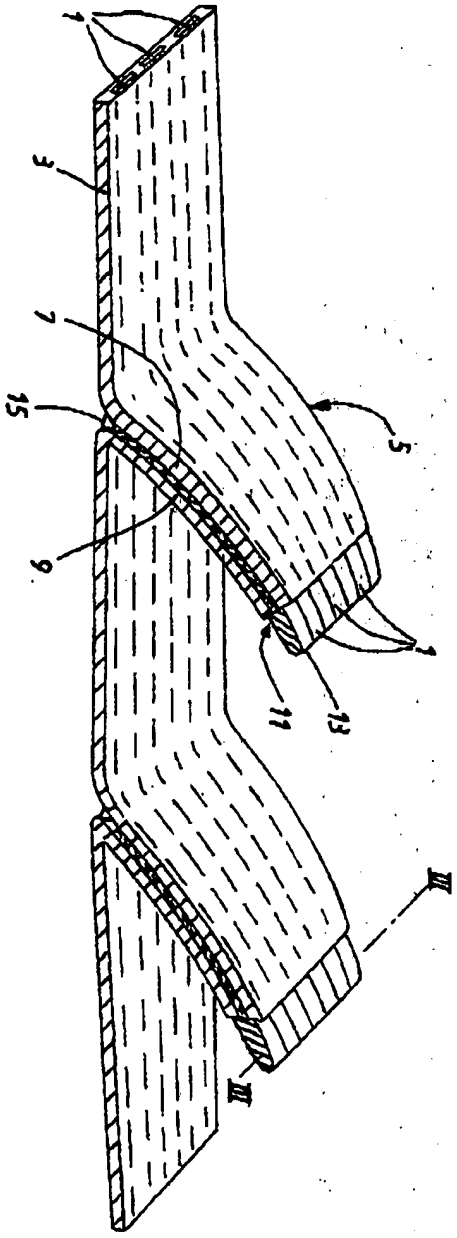

Fig. 1

1 523 602 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

Fig. 2

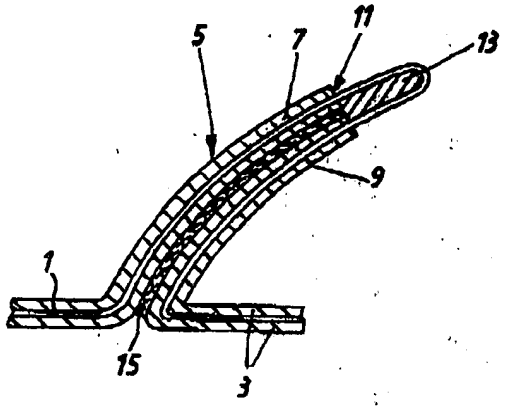

Fig. 3